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ON THE TRUE CHARACTER AND RELATIONSHIPS  
OF *URSUS CINNAMOMEUS* Aud. and Bach.

BY ARTHUR ERWIN BROWN.

The original description of *Ursus americanus* var. *cinnamomum*<sup>1</sup> was based by Audubon and Bachman mainly upon fur-traders' skins, and in the accompanying plate the animals were figured from living specimens seen by Audubon in the Garden of the Zoological Society of London.

They characterize the species, briefly, thus: "Form and size of the common American black bear, of which it is a permanent variety. Color above, a dark cinnamon brown; nose and a fringe of hairs covering the claws yellow;" and regarding its range, they say "sparingly found in the fur countries west and north of the Missouri, extending to the barren grounds of the northwest."

In the absence of all cranial and dental characters in their description, it has usually been supposed that their animals were nothing more than examples of the well-known brown phase of *Ursus americanus*, notwithstanding the fact that in their description of the latter species (*l. c.* p. 188) the authors show that they were familiar with its brown form and correctly estimated its position.

Specimens have recently come under my observation which appear to show what Audubon and Bachman's bear really was and that it is well distinguished from the form with which it has for so long been confounded.

The history of the material on which these conclusions are based is as follows:—In December, 1873, a male bear was received at the Garden of the Zoological Society of Philadelphia, from Ogden, Utah, which presented striking features of color and physiognomy when compared with the already known species of American bear. This specimen has always been associated in my mind with Audubon and Bachman's description, above quoted, but he is still living and the impossibility of making a detailed examination of his skull has hitherto prevented any definite conclusions from being reached. In 1884 a captive bear came to my notice at Green River, Wyoming,

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<sup>1</sup> Quad. of North America, 1854, Vol. III, p. 125, Pl. CXXVII.

which offered the same striking external features as the first. This animal I tried to purchase, but without success. Several years later I had the good fortune to kill a third specimen, also an old male, in the elevated and rugged region north of the White River, Colorado. The skin and skull were roughly prepared in camp, but were afterward irrecoverably lost. In November, 1891, the late James E. Cooper, a well-known showman of Philadelphia, procured, at some point on the Union Pacific Railway in Wyoming, and presented to the Zoological Society, another individual, identical in appearance with the three others. This specimen has since died and the skin and skeleton are now in the collection of the Academy. Finally, in the summer of 1893, Prof. E. D. Cope procured in a cave in the Ozark mountains, Missouri, a somewhat broken cranium of the same type, which he has kindly placed at my disposal for investigation. There are, therefore, presented for detailed examination two skulls, a skin and one living specimen now in the Zoological Garden, and while I am not able to give measurements from the skull collected by me in Colorado, the features of the species are so extreme that I am able to state without hesitation its substantial agreement with those now presented.

*Cranial characters.*—The first impression made by these skulls is of great breadth and massive development. The Academy's skull (No. 3,308) is short and broad, offering the following measurements in millimeters:—Basal length 274; basilar length 270; extreme length 288; greatest zygomatic width 203; post palatal length 123; length of palate 147; breadth between orbits 74; across postorbital processes 105. The Ozark skull has lost a considerable portion of the facial region, but the difference in size between it and 3,308 was small; the distance from the inferior lip of the foramen magnum to the plane of the front of the fourth premolar, being in the latter 212, while in the Ozark specimen it is 216; in this one the zygomatic width is about 198; interorbital breadth 80; across postorbital process 114.

The sagittal crest is high and massive, measuring in each 130 to the point of division into the temporal ridges, which are strong, especially in 3,308. The forehead is very concave, more so than in any bear skull I have seen. In 3,308 it is also transversely concaves differing from the Ozark specimen, in which the same region is transversely convex. This specimen was perhaps a female. The

nasals in both are short and rather broad. A most striking feature is the great breadth of the zygomatic arch, anteriorly, which character, more than any other, gives to the living animal its peculiar physiognomy. In 3,308 the width at the glenoid fossae is 203; at the hinder end of the palate it is but 5 mm. less and at the plane of the hinder edge of the second molar it is still 180. The broken condition of the Ozark skull prevents the corresponding measurements from being given, but enough remains to show their essential agreement. In keeping with this character is the increased width of the palate posteriorly, which measures 45 at plane of anterior edge of fourth premolar and 52 at rear end of hinder molar.

The base of skull is somewhat concave; a line from the inferior edge of foramen magnum to the proximal border of the alveolus in 3,308 falls 16 mm. below the hinder end of the palate.

The lower jaw is massive and heavy; the angular process strong and curved upward; the fossa for attachment of the masseter is extraordinarily deep and rough.

*Dental characters*:—The teeth in both skulls are much worn. The hinder molar in the upper jaw is relatively of great size; in the Academy's skull being .118 of the basilar length. The complete series measures:  $m^3 \frac{32 \times 16}{19 \times 14}$ ,  $m^2 \frac{32 \times 16}{22.5 \times 15}$ ,  $m^1 \frac{19 \times 14.5}{20 \times 10}$ ,  $pm^4 \frac{14 \times 11}{11.5 \times 8}$ . In the Ozark skull the lower jaw is missing and the only teeth remaining are the upper right molars; these measure:  $m^2 \frac{31 \times 17}{13 \times 9}$ ,  $m^1 \frac{19 \times 15}{13 \times 9}$ ,  $p m^4 \frac{13 \times 9}{13 \times 9}$ . The crowns of the teeth have been worn almost away and it is clear that the hinder molar, especially, measures less than at an earlier period. The second upper molar is broad and rounded behind, the width being carried pretty well back to the posterior end; in the Ozark specimen the outer side is somewhat sloped off behind as in *horribilis*, although it may be doubtful if this condition was marked in the unworn tooth; there are three inner and two outer cusps. The first molar is short and broad, with four cusps. The fourth premolar is rather short and narrowed in front, the shelf-like projection of the cingulum on the forward inner corner being less than in the grizzly.

The lower teeth are much worn; the fourth premolar had one cusp, from which there are remains of two longitudinal ridges to the hinder end; it is not easy to say whether the small tubercle on the inner base of the cusp was also present, but there is some indication that it was.

*Color and form.*—The living specimens of this bear which have been under observation were of similar color, in winter pelage a rich cinnamon brown. The two which have lived in the Zoological Garden for more than one season, became in summer of a pale bleached brown, or isabella color. The skin in the Academy's collection, belonging to skull 3,308 is almost flaxen.

The size of the four living specimens was nearly the same, about 5 ft., 6 in. from nose to tail.

The claw is short and curved as in *americanus*.

The great anterior width of the zygomatic arch and the hollow forehead are faithfully reflected on the outer surface in these bears, the sharp drop between the eyes and the laterally pinched-in muzzle giving them a peculiar and unmistakable, fox-like look.

*Identity and relationship.*—In studying out the correct assignment to be made of these bears, a considerable mass of material has been examined, including, through the kindness of Mr. Oldfield Thomas, the series of *arctos* and other bears in the British Museum; and also the collection of the Royal College of Surgeons, London.

The great range of individual variation in most species of *Ursus*, is well known: in my own observations amounting, in the leading proportions of the skull, to over twenty per cent. in *arctos*; sixteen per cent. in *americanus*, with a somewhat smaller range in *horribilis*.

The table following shows the main standard measurements of the skull in *cinnamomeus*, *arctos*, *horribilis* and *americanus*, arranged for convenience of comparison in the descending order of proportional breadth; the skulls selected for measurement pretty well covering the extreme range in both directions. The proportions of zygomatic breadth and length of hinder upper molar are expressed in thousandths of the basilar length :—

	Length.			Breadth	Proportion	
	Extreme	Basilar	of 2d molar	Zygomatic	of breadth	of 2d molar
<i>cinnamomeus</i>	288	270	32	203	.751	.118
“			31	198	.712 <sup>2</sup>	.112 <sup>2</sup>
<i>arctos</i>	345	318	30	250	.786	.094
“	368	338	36	250	.739	.106
“	330	306	30	218	.712	.098
“	383	353	38	250	.708	.107
“	330	299	34	210	.702	.113
“	354	329	35	230	.699	.106
“	295	272	33	177	.650	.121
“	344	315	35	190	.603	.111
<i>horribilis</i>	352	335	38.5	221	.659	.114
“	330	306	37	200	.653	.121
“	302	291	32	189	.649	.109
“	350	323	36	200	.619	.111
“	371	343	36	210	.612	.105
<i>americanus</i>	282	262	26	188	.717	.099
“	280	262	28	179	.683	.106
“	279	259	25.5	170	.656	.098
“	289	268	25	175	.652	.092
“	302	282	27	172	.609	.095
“	304	290	25	170	.586	.086

Taking the mean measurements of these skulls, *horribilis* presents the narrowest, with a relative average breadth of .638 and a molar of .112,—its maximum breadth falling far below that of *americanus*, from which it differs also in color, size and claw.

The great frontal concavity, breadth of skull and more than all, great size of the molar, would appear to remove *cinnamomeus* very far from *americanus*, but this comparison will be recurred to after considering the variations of *arctos*.

In both of the proportions given, *cinnamomeus* greatly exceeds the average of *arctos*, which is breadth .700; molar .107,—in each, however, it falls within the extremes of this unstable species, the greatest

<sup>2</sup> Estimated; the skull being broken.

proportional breadth in *arctos* being .786 and the longest molar .121<sup>3</sup>. This very wide *arctos* skull, however, presents the striking feature of having the smallest molar of any examined by me .094—and, in fact, these measurements show that in this species an inverse proportion pretty constantly exists between these characters; the widest skulls have small molars, while the narrower ones have them of large size and grade by a regular series into the proportions of *horribilis*. Thus, in the eight *arctos* skulls given above, the four widest give an average length of .101½ to the molar, while the four narrowest give .112¾ for the corresponding ratio. In contradistinction to this inverse relation, the exact opposite exists in *cinnamomeus*,—great breadth being here conjoined with great size of molar.

In some old skulls of *arctos* a considerable hollowness of the forehead is found, but in no case equal to that of 3,308 and the Ozark skull. These features of great breadth, frontal concavity and great massiveness are, of course, among those which increase with age, but it is a significant fact that we find them associated here in skulls of very moderate size. The individuals of *cinnamomeus* which have come under my notice were very old, three being males and the fourth perhaps female; they are so nearly equal in size that they may be justly assumed to represent a fair extreme of growth for the species. In 3,308 the skull is 288 mm. in greatest length, while to find anything like an approximation to the same characters in *arctos* or even to get correspondingly old skulls, it is necessary to go to those from 50 to 80 mm. greater in length.

Comparing the above proportions, *cinnamomeus*, while greatly exceeding in both, the average of *arctos*, is yet surpassed in breadth by one example and in length of molar by one;—*arctos* has two specimens narrower than the broadest *horribilis*, one of them being the narrowest of either species and six have larger molars than the shortest of the American form. The difference in average breadth between *arctos* and *americanus* is comparatively small and they overlap greatly, while the largest molar of the latter species is equal to, or larger than four of *arctos*.

It is impossible to avoid the conclusion that these proportions are too irregular to be of importance except in groups of averages, and

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<sup>3</sup> This skull is not fully adult and is the shortest examined. With maturity the proportions of this tooth would somewhat decrease.

their lack of value as specific characters may be readily estimated from the following table, in which they are presented for each form, in parallel descending series, showing at a glance the extent to which each overlaps the others:—

Proportion of breadth				Proportion of 2d molar			
cinn.	arctos	horr.	amer.	cinn.	arctos	horr.	amer.
.751	.786			.118	.121 <sup>5</sup>	.121	
	.739					.114	
.712 <sup>4</sup>			.717	.112 <sup>4</sup>	.113		
	.712				.111	.111	
	.708					.109	
	.702				.107		
	.699				.106		.106
		.659	.683		.106	.105	
			.656				.099
		.653	.653		.098		.098
	.650						.095
		.649			.094		
		.619					.092
		.612					.086
			.609				
	.603						
			.586				

Nor is there more constancy in the details of tooth structure. On the whole, *arctos* presents an upper hinder molar perhaps straighter on the outer line and wider at its hinder extremity than is usual in most of *horribilis*, but the variations are great in both. Two adult skulls of *horribilis*, collected by me in Colorado, within fifty miles of each other, exhibit almost the extreme of each form.

The fourth upper premolar is apt to be longer in *arctos* and in *horribilis* there is more of a shelf-like projection of the cingulum at its front inner corner, but hardly any two are alike and in each, ex-

<sup>4</sup> Estimated    <sup>5</sup> Young.

amples are to be found approximating to the narrow front usual in *americanus*. In *arctos* and *horribilis* the fourth lower premolar has but one cusp, on the posterior, inner base of which a small projection or accessory cusp is usually found in the latter, with two longitudinal ridges running back to end of the tooth. According to Busk<sup>6</sup> the tubercle and its ridge are commonly wanting in *arctos* and when present are very small. In two specimens in the British Museum, both tubercle and ridge are absent, in all the others it is present, though variable and small—but in one specimen of *Ursus arctos isabellinus* from Cashmir, it is quite as well developed as in ordinary cases of *horribilis*. Dr. C. Hart Merriam<sup>7</sup> appears to have found this tubercle in two skulls of *americanus* from Prairie Mer Rouge, Louisiana, in the National Museum. In the skull of *cinnamomeus* (3,308) the ridge is unquestionably present and in all probability the tubercle as well.

A tricuspid crown on this tooth appears to be diagnostic of *americanus* when it is present, but a large majority of this species examined by me, show but one cusp.

A critical survey of the whole field of cranial and dental characters among the species here treated, reveals little that is constant but variation, and absolutely forces the conviction that among them there is not one, sufficiently stable and uniform to be of specific value. The European bear and the American grizzly run into each other so regularly that except in extreme cases there is little possibility of distinguishing them certainly, or in many cases doubtfully, apart from geographical considerations, and this even is not a safe guide, one skull in the British Museum, marked “Barren Ground Bear,” 321 mm. in extreme length, 229 zygomatic breadth and 32 length of molar, being in all respects an ordinary skull of *arctos*, which might just as well have been collected in Scandinavia or Kamtchatka. Mr. J. A. Allen<sup>8</sup> does, in fact, regard this bear as indistinguishable from *arctos*<sup>9</sup>. There is less difficulty in separating *americanus* from *arctos*, but even here it has been shown how much their proportions overlap and one specimen from Transylvania,

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<sup>6</sup>Trans. Zool. Society of London, Vol. X, pp. 60-69.

<sup>7</sup>Proc. Biol. Soc. of Washington. Vol. VIII, p. 150.

<sup>8</sup>Bull. U. S. Geo. & Geo. Survey, Vol. II, p. 336.

<sup>9</sup>Since the above was written Dr. Merriam has kindly shown me several skulls from the barren grounds which have distinct characters of their own.

in the British Museum, 295 mm. long, presents the flat frontal outline and the relative width of the American black species, coupled with the extreme dentition of *arctos*.

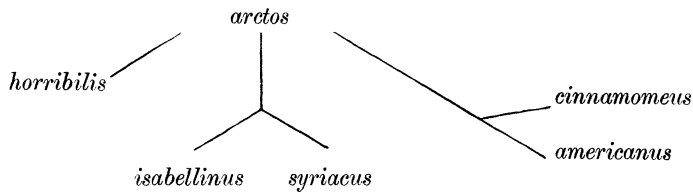
Skulls of *americanus* reach nowhere the extreme proportions of *cinnamomeus*, nor in ordinary specimens is there much suggestion of its outlines. Two remarkable skulls, however, in the collection of the Academy (Nos. 2,756 and 2,757) from Sonoma Co., California, marked "brown bear" reach an extreme of breadth and length of tooth, in this species, with a frontal depression almost equal to that of *cinnamomeus*, although in the Sonoma specimens the plane of the forehead is continuous nearly to the end of the nasals and is but slightly concave. These two skulls are the most extreme of *americanus* which I have ever seen, but while I would have been glad to examine more specimens of these brown bears than have been within reach, I am yet prepared to hazard the belief that fully matured specimens will show, as compared with black ones, a sometimes slight but fairly constant excess both in breadth and size of molar.

There can be here no question of specific difference, both colors being found in the same litter of cubs and the fact can be explained only by regarding it as an evidence of reversionary tendency to a brown-colored, large-toothed ancestor,—such as *arctos*; the physiological correlation between hair and teeth being well known. If, as I believe, the foregoing suggestion should be found to hold good in a large series, there is certainly a tendency in brown specimens of *americanus* toward the characteristics of *cinnamomeus*, and here also, perhaps, room may be found for the special features of the Louisiana skulls in the National Museum which Dr. Merriam<sup>10</sup> recently ascribed to *Ursus luteolus* Griffith.

From these observations the conclusion is drawn that if *horribilis*

*americanus* is concerned, viz.: that leaving out *maritimus*, none of our North American bears can be accorded higher rank than that of subspecies of *arctos*. Indeed were it not for the combination of certain skull and tooth averages, with some tolerably constant differences in color and the increased size of the claw in American specimens, it is doubtful if even this distinction could be maintained between *arctos* and *horribilis*; both the large, broad-headed grizzlies of California and the smaller, northern examples, pretty well closing up the gap.

In extreme cases *americanus* has become more differentiated and is constantly smaller, but even here we have seen that the assumed specific characters intergrade; it is, however, better separated from *arctos* than is *horribilis*, and through its extreme forms the path to *cinnamomeus* is perhaps indicated—as a large series of the latter may show. Among Asiatic bears, *isabellinus* and probably *syriacus* are also closely related. The general direction of these relationships appears to point to some such scheme as this:



Audubon and Bachman's name appears to be correctly applicable to the bears whose cranial and dental characters are here given for the first time. They agree sufficiently well in external features and in geographical range as far as we have present knowledge, and the assignment which I here make of them, I must regard as much preferable to the alternative course of imposing upon them a new name. In the paper on *Ursus luteolus*, already referred to, Dr. Merriam denies the applicability of *cinnamomeus* to *luteolus*, and inferentially to the present species, "because *cinnamomum* was based on an animal from the northern Rocky Mountains, which has small molars, like the common black bear of the northeastern United States." This assumption, however, has no basis but in the fact that up to the present time we have known no brown bear from the Rocky Mountain region other than the small-toothed *americanus*, which has erroneously been supposed to be the animal on which Audubon and

Bachman founded their species, and falls to the ground with the appearance of the animal brought forward in this paper, leaving their name free to be properly rehabilitated and established. Any other course would be to hold these authors responsible for our own past ignorance and would lack in justice to them.